



CCSDS File Delivery Protocol (CFDP)

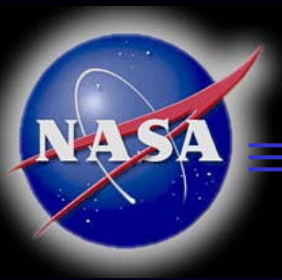
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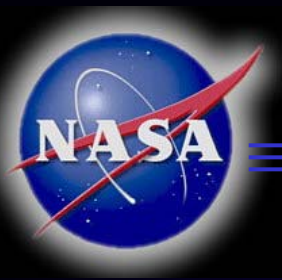
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AGENDA

- ◆ Why CFDP?
- ◆ What is it?
- ◆ How does it work?

(CCSDS = Consultative Committee for Space Data Systems)



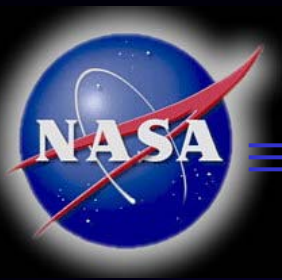
Why CFDP? - Summary

- ◆ *Loads and Dumps* need improvement
- ◆ How? Use reliable file transfer protocol
- ◆ Which one?
 - ❖ Depends on your perspective
 - ❖ From NASA-wide perspective, use CFDP.



Why CFDP?

- ◆ *Loads* and *dumps* need improvement:
 - ❖ Individual commands use CCSDS Telecommand protocols; reusable code
 - ❖ Real-time telemetry uses CCSDS Telemetry protocols; reusable code
 - ❖ Commands *loads* (of on-board programs/tables) require *custom* code for most missions.
 - ❖ Telemetry *dumps* (of science data) require *custom* code for most missions.



Why CFDP?

- ◆ How to improve Loads and Dumps?
 - ❖ Loads and dumps are “file” transfers
 - ❖ Use a reliable file transfer protocol
 - ❖ Enables code reuse and increased automation



Why CFDP?

- ◆ Which file transfer protocol?
 - ❖ Mission manager perspective
 - ◆ One that works well for *my* mission
 - ❖ NASA-wide perspective
 - ◆ One that works well for *all* missions
 - ◆ Reusable (*stable* standard)
 - ◆ Compatible with *both* existing infrastructure and IP



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Why CFDP? – Protocol comparison

<u>Protocol</u>	<u>Missions?</u>	<u>Stable?</u>	<u>Exist+IP?</u>
FTP	Some	Y	
CFDP	All	Y	Y
MDP	Some/All		
NORM	?		



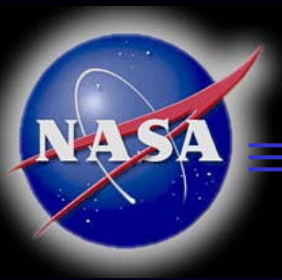
Why CFDP? – Conclusion

- ◆ NASA-wide choice is CFDP
 - ❖ Works well for all missions (including near-Earth and Deep Space)
 - ❖ Stable (high probability of long-term reuse)
 - ❖ Compatible with both existing infrastructure and IP



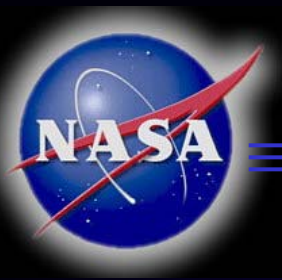
What is CFDP? – Summary

- ◆ *Virtual Filesystem*
 - ❖ CFDP delivers a block of data and a “filename”
 - ❖ “Filename” maps to a *Virtual Filesystem*
 - ❖ One CFDP *node* per Virtual Filesystem
- ◆ Reliable file delivery
 - ❖ *Within* CFDP = Acknowledged Service
 - ❖ By a lower layer = Unacknowledged Service
- ◆ Point-to-point; extensions support multiple hops



What is CFDP? – Features

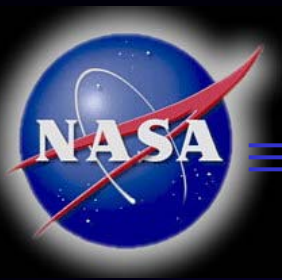
- ◆ Pause one transaction
- ◆ Pause all transactions (between passes)
- ◆ Filestore directives (e.g. rename file)
- ◆ Record-oriented files
- ◆ User Messages



What is CFDP? – Implementer's view

- ◆ Reusable core module
 - ❖ *Protocol engine*

- ◆ Implementation-specific interface modules
 - ❖ *User*
 - ❖ *Virtual Filesystem*
 - ❖ *Lower-layer communications*
 - ◆ IP-related issues restricted to this module
 - ◆ Extensive CFDP/UDP experience



How does it work? – Summary

- ◆ Transaction initiated by *Put Request* from User
- ◆ Sender transmits the whole file once.
 - ❖ Each “chunk” identifies its offset within file.
- ◆ For Acknowledged Service:
 - ❖ Repeat as necessary:
 - ◆ Receiver reports any gaps.
 - ◆ Sender retransmits gaps
 - ❖ Receiver reports “Finished”; Sender acknowledges.



How does it work? – First, Sender drives...

- ◆ *Metadata* →
 - ❖ Source, destination, filename
 - ❖ Optional: Filestore Directive(s)
 - ❖ Optional: User Messages
 - ❖ Optional: non-default error-handling
- ◆ *File-data* →
 - ❖ One per “chunk”; includes offset
- ◆ *EOF* →
 - ❖ Specifies file length, includes file checksum
- ◆ (for Unacknowledged Service, done)



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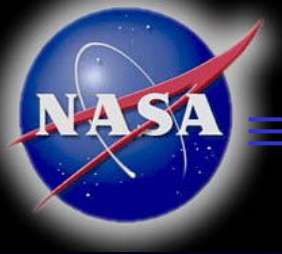
How does it work? – ... then Receiver drives.

- ◆ \leftarrow *Ack-EOF*
- ◆ \leftarrow *Nak*
 - ❖ Specifies missing data
 - ❖ (Deferred Nak; other modes exist)
- ◆ *File-data* \rightarrow ...
- ◆ \leftarrow *Finished*
- ◆ *Ack-Finished* \rightarrow



How does it work? – Timers provide flexibility

- ◆ Ack-timer
 - ❖ Ensures EOF and Finished are delivered
 - ❖ Mission-configurable
- ◆ Nak-timer
 - ❖ Ensures feedback is provided periodically
 - ❖ Mission-configurable
- ◆ Transaction-lifetime-timer
 - ❖ Clears out zombies
 - ❖ Mission-configurable



How does it work? – User Requests

- ◆ *Put*
 - ❖ Starts a transaction.
- ◆ *Cancel*
 - ❖ Cancel one transaction.
- ◆ *Suspend/Resume*
 - ❖ Affects one transaction
- ◆ *Freeze/Thaw*
 - ❖ Pause *all* transactions (between passes).



References

- ◆ Web sites:
 - ❖ www.ccsds.org - CCSDS documents
 - ❖ www.ccsds.com - commercial support
- ◆ CFDP documents:
 - ❖ CCSDS 727.0-B-2 (protocol specs)
 - ❖ CCSDS 720.1-G-1 (explanation)
 - ❖ CCSDS 720.2-G-1 (Implementers Guide)
- ◆ For info on core CFDP:
 - ❖ Timothy.J.Ray@nasa.gov 301-286-0581
- ◆ For info on multi-hop scenarios:
 - ❖ Scott.Burleigh@jpl.nasa.gov



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3. CCSDS File Delivery Protocol (CFDP): Tim Ray
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10. CCSDS Link Layer Protocol Suite: Greg Kazz

